

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 09/23/2003 has been entered.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. Claims 11, 13, 15 and 16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Obeng et al. (U.S. 6,323,131) in view of Asai et al. (U.S. 5,736,770) and Cheung et al. (U.S. 6,153,521).

In reference to claims 11, 13 and 15, Obeng et al. (Fig.1) in a related method to form a copper damascene structure teach the steps of making a first concavity (16) in a first insulating film (10) of a substrate (12); covering the first concavity (16) with a first barrier layer (18) for preventing metal diffusion; burying the first concavity (16) covered with the first barrier layer (18) with a copper layer (20); polishing the copper layer (20) to remove a part of the copper layer (20) residing higher than the upper peripheral level of

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the first concavity (16) so as to leave a first copper layer (22) in the first concavity; applying a solution of an organic substance to the device so as to form a protective film (24) of the organic substance on a surface of the first copper layer (22) for preventing metal diffusion, said organic compound comprising an alkanolamine; forming a second insulating film (Fig.1(d), 10) over the first insulating film (10) and the protective film (24); making a second concavity in the second insulating film (Fig.1(d), 10) and the protective film (24) in a region above the first copper layer (22); covering the second concavity with a second barrier layer (Fig.1(d), 18); and burying the second concavity covered with the second barrier layer with a second copper layer (Fig.1(d), 20), the second copper layer (Fig.1(d), 20) contacting the first copper layer (22) (column 2, line 50, column 4, line 35).

Obeng et al. fail to teach forming a second insulating film contacting the first insulating film and the protective film. However, Asai et al. (Figs.3-9) in a related method to form an interconnect structure teach the steps of forming a second insulating film (6) contacting a first insulating film (13) and a protective film (11), the protecting film (11) overlying a conducting layer (9) (column 3, line 65 – column 7, line 3). Therefore, it would have been obvious to form a second insulating film as taught by Asai et al. in the damascene manufacturing process of Obeng et al., since this would provide protection of the underlying conductive layer and improve planarity of the device (column 5, lines 24 – 61).

Still the combined teachings of Obeng et al. and Asai et al. fail to teach making the second concavity simultaneously in the second insulating film and the protective film. However, Cheung et al. (Figs.1-5) in a related method to form interconnects teach

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/658,193	09/08/2000	Takayuki Niuya	08038.0032	2409

22852 7590 10/09/2003

FINNEGAN, HENDERSON, FARABOW, GARRETT & DUNNER
LLP
1300 I STREET, NW
WASHINGTON, DC 20005

EXAMINER

MALDONADO, JULIO J

ART UNIT PAPER NUMBER

2823

DATE MAILED: 10/09/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/658,193

Applicant(s)

NIUYA ET AL

Examiner

Julio J. Maldonado

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 23 September 2003.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 11-16, 20 and 21 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 11-16, 20 and 21 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 08 September 2002 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____
- 4) ☐ Interview Summary (PTO-413) Paper No(s) _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other:

forming a concavity in a multiple dielectric stack (32, 34, 36) using a single etching step, and selecting the etchants depending on the materials used to form the multiple dielectric stack (32, 34, 36) to perform said single etching step (column 4, lines 41 – 56). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to combine the teachings of Obeng et al and Asai et al. with the teachings of Cheung et al. to enable performing a single etching step as taught by Cheung et al. in the interconnect formation process of Obeng et al. and Asai et al.

In reference to claim 16, the combined teachings of Obeng et al., Asai et al. and Cheung et al. teach washing the device to eliminate particles therefrom after the polishing (column 3, lines 23 – 30 and column 4, lines 26 – 30).

4. Claim 12 is rejected under 35 U.S.C. 103(a) as being unpatentable over Obeng et al. ('131) in view of Asai et al. ('770) and Cheung et al. ('521) as applied to claims 11, 13, 15 and 16 above, and further in view of Avanzino et al. (U.S. 6,350,687).

In reference to claim 12, Obeng et al. in combination with Asai et al. and Cheung et al. substantially teach all aspects of the invention but fail to show the organic substance is a triazole compound. Nevertheless, Avanzino et al. (Fig.1-5) in a related method to form a protective layer to a copper damascene teach forming a protective layer over a copper damascene, said protective layer comprising a triazole compound (column 5, line 11 – column 7, line 39). Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention was made to form the protective layer of the triazole compound as taught by Avanzino et al. on the surface of the first metal layer of Obeng et al. Asai et al. and Cheung et al., since by doing so it would prevent

the formation of a thick oxide layer from the surface of the copper layer (column 5, lines 1-16).

5. Claims 14, 20 and 21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Obeng et al. ('131) in view of Asai et al. ('770), Cheung et al. ('521), Avanzino et al. ('687) and Endo et al. (U.S. 5,795,828).

In reference to claims 14 and 20, Obeng et al. (Fig.1) in a related method to form copper damascenes teach the steps of making a first concavity (16) in a first insulating film (10) on a surface of a substrate (12); covering the first concavity (16) with a first barrier layer (18) for preventing metal diffusion; burying the first concavity (16) covered with the first barrier layer (18) with a wiring metal (20) comprising copper; polishing the device to remove a part of the wiring metal (20) residing higher than the upper peripheral level of the first concavity (16) so as to leave a first metal layer (22) in the first concavity (16); applying a solution of a compound onto the surface of the device so as to form a protective film for preventing metal diffusion on a surface of the first metal layer (22); forming on the surface of the substrate (12) a second insulating film (Fig.1d, 10) directly connected to the first metal layer (22); making a second concavity (Fig.1d) in the second insulating film (Fig.1d, 10) in a region above the first metal layer (22); covering the second concavity (Fig.1d) with a second barrier layer (Fig.1d, 18), and burying the second concavity (Fig.1d) covered with the second barrier layer (Fig.1d, 18) with a second wiring metal layer (Fig.1d, 20), the second wiring metal layer (Fig.1d, 20) contacting the first metal layer (22) (column 2, line 50, column 4, line 35).

Obeng et al. fail to teach forming a second insulating film contacting the first insulating film and the protective film. However, Asai et al. (Figs.3-9) in a related method to form an interconnect structure teach the steps of forming a second insulating film (6) contacting a first insulating film (13) and a protective film (11), the protecting film (11) overlying a conducting layer (9) (column 3, line 65 – column 7, line 3). Therefore, it would have been obvious to form a second insulating film as taught by Asai et al. in the damascene manufacturing process of Obeng et al., since this would provide protection of the underlying conductive layer and improve planarity of the device (column 5, lines 24 – 61).

Still the combined teachings of Obeng et al. and Asai et al. fail to teach making the second concavity simultaneously in the second insulating film and the protective film. However, Cheung et al. (Figs.1-5) in a related method to form interconnects teach forming a concavity in a multiple dielectric stack (32, 34, 36) using a single etching step, and selecting the etchants depending on the materials used to form the multiple dielectric stack (32, 34, 36) to perform said single etching step (column 4, lines 41 – 56).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to combine the teachings of Obeng et al and Asai et al. with the teachings of Cheung et al. to enable performing a single etching step as taught by Cheung et al. in the interconnect formation process of Obeng et al. and Asai et al.

Obeng et al. in combination with Asai et al. and Cheung et al. fail to teach the protection film is a metal layer, said metal layer is electroless plating deposited by using a salt of stannous chloride, stannous borofluoride, stannous sulfate, nickel chloride, or

nickel sulfamate. Nevertheless, Avanzino et al. (Fig.1-5) in a related method to form protective film on a copper damascene teach treating the surface of the copper layer with a metal protective film deposited by electroless plating. Therefore, it would have been obvious to one of ordinary skill in the art at the of the invention was made to form a metal layer over the copper damascene as taught by Avanzino et al. in the copper damascene of Obeng et al., Asai et al. and Cheung et al., since the formation of a thick oxide layer over the copper layer is prevented by such treatment (column 5, lines 1-16).

Obeng et al. in combination with Asai et al., Cheung et al. and Avanzino et al. fail to teach using stannous chloride, stannous borofluoride, stannous sulfate, nickel chloride, or nickel sulfamate to form the protection film. However, Endo et al. in a related method to form damascene teach forming a metal layer using stannous chloride, stannous borofluoride, stannous sulfate, nickel chloride, or nickel sulfamate by electroless plating (column 4, lines 43-49). Therefore, it would have been obvious to one of ordinary skill in the art to use the nickel chloride as taught by Endo et al. in the combination of Obeng et al., Asai et al., Cheung et al. and Avanzino et al., since nickel chloride is well-known material used for the deposition of metallic nickel by electroless plating (column 4, lines 20-56).

In reference to claim 21, the combined teachings of Obeng et al., Asai et al., Cheung et al. and Avanzino et al. teach washing the device to eliminate particles therefrom after the polishing (column 3, lines 23 – 30 and column 4, lines 26 – 30).

Response to Arguments

6. Applicant's arguments with respect to claims 11, 14, 16 and 21 have been considered but are moot in view of the new ground(s) of rejection.

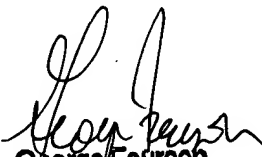
Conclusion

7. Papers related to this application may be submitted directly to Art Unit 2823 by facsimile transmission. Papers should be faxed to Art Unit 2823 via the Art Unit 2823 Fax Center located in Crystal Plaza 4, room 3C23. The faxing of such papers must conform to the notice published in the Official Gazette, 1096 OG 30 (15 November 1989). The Art Unit 2823 Fax Center number is **(703) 305-3432**. The Art Unit 2823 Fax Center is to be used only for papers related to Art Unit 2823 applications.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to **Julio J. Maldonado** at **(703) 306-0098** and between the hours of 8:00 AM to 4:00 PM (Eastern Standard Time) Monday through Friday or by e-mail via julio.maldonado@uspto.gov. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri, can be reached on (703) 306-2794.

Any inquiry of a general nature or relating to the status of this application should be directed to the **Group 2800 Receptionist** at **(703) 308-0956**.


JMR
9/30/03


George Fourson
Primary Examiner